

## **Risk Based Analysis Implications for Floodplain Management**

by

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In the early 1990s, risk based analysis methods were being developed by the US Army Corps of Engineers. During this time, the Association of State Floodplain Managers became increasingly concerned with this departure in design methodology. In part this concern was fueled by:

- a. The basis for change, as communicated to ASFPM, was to satisfy an OMB desire to justify why significant amounts of money were spent on freeboard.
- b. Initial results that indicated that with risk based methods that many existing levees would have been built to a lower elevation, during a period of time when levee failure and catastrophic damages was in the daily news.
- c. A dramatic change in approach where we were moving from saying that uncertainty could not be quantified but based on engineering experience we should use a safety factor called freeboard; to an approach that said we can now quantify uncertainty through statistical simulation of numerous independent factors that impact performance.
- d. Difficulty in communicating method impacts on Non-Corps applications.
- e. Early FEMA acceptance of risk based analysis with little consideration of how "level of protection", e.g. 100-year flood, relates to risk base terms such as the conditional non-exceedence (CDN or reliability) or the exceedence probability.

In essence communications and levels of trust were marginal. However, currently (October 1997) it appears that there can be considerably more comfort with risk and uncertainty methods providing the following is considered and incorporated.

1. Communications - A significant factor influencing ASFPM's early reluctance was the inability to communicate the shift. To maintain separation between traditional methods driving most floodplain management and stormwater management programs and to meet internal Corps of Engineer missions for economic analysis there always has been and will continue to be a reluctance to use level of protection as a descriptive output. In part from a risk base perspective this is due to the fact that we really can not ever report an absolute level of protection with 100% confidence. Risk base substitutes for level of protection the Exceedence Probability that is further qualified by the CDN or reliability. While from an academic perspective this makes infinite sense; from a program management perspective this opens the door for significant confusion and potential abuse. The

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ASFPM strongly urges that the level of protection concept be sustained and as needed its definition modified to include risk based terms as appropriate. For this recommendation to be viable there is a need to mesh recommendation #2.

2. **CDN or Reliability** - Inherent to the exceedence probability is the CDN or reliability factor. The CDN when linked with the exceedence probability provide a complete view of "level of protection". Based on these linked results it is feasible to report the estimated reliability for a given structure to pass various return period flows. For example the same facility may have a 99% reliability for passing a 10-year flood, a 95% reliability for passing a 100-year flood, an 85% reliability for passing a 200 year flood, and a 60% reliability for passing a 500-year flood. While this is something that can be quite useful for performing robust economic analysis, it becomes confusing and difficult to describe for the practitioner or the regulator that is attempting to sustain a required level of protection. For uses of the method that are attempting to report "level of protection" (now defined to include both exceedence and CDN), it is necessary to establish a minimal level of reliability where a given level of protection can be ascribed. This is similar to , but need not be as complex, as the current certification process developed by FEMA and the Corps. The ASFPM strongly urges that an expert committee be conferred that would assign minimal levels of reliability to various structure types , field situations, and that would include state definitions of protection levels. For example perhaps levees would maintain 90 or 95% reliability for all urban applications, and perhaps would maintain a lesser level of reliability for nonurban applications or applications that would be for a lesser level of protection.
3. **Training** - There is an absolute need to begin to communicate risk based analysis to practitioners. This communication process should not occur however prior to coming to agreement on the new definition for level of protection. At that time the education can be conducted in two phases. Phase one is a simplified explanation that should assure users and community officials that there is an improved method of accounting for uncertainty when developing estimates of level of protection. Phase two would be training in the application of risk based analysis.
4. **Peer Review and Black Box** - The probabilistic background of risk based analysis exceeds the educational level for many practitioners, and exceeds the comfort level for most practitioners. To assure the validity of the approach it is essential to occasionally use independent research bodies that can investigate the approach and confirm that the method reasonably accounts for uncertainty in design. The National Academy of Science review called for in WRDA 96 is a good example of how these reviews could be approached.

In addition there is a need to develop some simplified tools that allow for the user of risk base to validate whether the results are within the range of reasonableness. These estimates are not intuitive, and as with any modeling exercise is an important component for quality control.

5. State Lead - It is essential to understand that the management of the nation's floodplains is a state and local government responsibility. As the Corps proceeds with the implementation of risk based analysis it is essential to keep in mind that when State Laws and Standards exceed federal criteria that designs should be accomplished that meet these designs. This is not to suggest that if a state criteria leads to a project that exceeds the federal "interest" that the increased costs automatically become a federal cost; but this is clearly an issue that would warrant ongoing work between the Corps, the States, and Congress.

With the accomplishment of the above recommendations and continued acknowledgement from the Corps of Engineers that risk based methods must be implemented with a careful eye towards impact on state and local floodplain management programs, the ASFPM is becoming optimistic that a tool is being developed that can improve our ability to quantify and manage flood risks.

